MORPHO-TAXONOMICAL STUDIES ON THE GENITALIA AND SALIVARY GLANDS OF SOME CIMICOMORPHA (RHYNCHOTA, HEMIPTERA)

BY

R. KUMAR

Department of Zoology, Birla College, Pilani, India

Introduction

While extensive studies have been made on the internal reproductive organs of Cimicomorpha (Carayon, 1946, 1952, 1953, 1954, 1955, 1958, etc.), not much attention seems to have been devoted to the study of external genitalia and salivary glands in this group. Amongst Cimicomorpha, Reduviidae alone consist of as many as thirty sub-families, the inter-relationships of which are not clear. Davis (1957) in his excellent review of Reduvioidea points out that "Information regarding the morphology of the genitalia of most sub-families is lacking". Villiers (1948) in his monumental work on African Reduviidae studied female genitalia only superficially. He overlooked styloids, so well developed and consistently present in Reduviidae. Neither did he realise the value of endosomal sclerites ("phanares") of male genitalia in judging the relationships of the sub-families and also he overlooked struts, while Pruthi (1925) described only struts and ignored endosomal sclerites. The main objective of the present investigation has been therefore, to study the possible systematic value of these organs in Reduviidae and furnish additional morphological data in some other families of Cimicomorpha. Although only six sub-families of Reduviidae could be studied, the value of genitalia for understanding their relationships has been clearly demonstrated. It is hoped that interpretations and conclusions as presented here will further aid in understanding the affinities of the families and sub-families of the group.

Material and Methods

Excepting the Australian *Opisthoplatys* and *Gminatus*, the material was collected by the author in Pilani, a semi-arid region of India. Terminal portion of abdomen was removed and boiled in 10 per cent KOH, passed through glacial acetic acid and cleared in methyl salicylate. Separation of the various parts of different structures was carried out under a low power microscope, by means of entomological pins mounted on wooden handles, after the structures had gained sufficient transparency and strength.

TERMINOLOGY

Female genitalia

As far as female external genitalia are concerned, the terminology and interpretations of SNODGRASS (1933) have been followed. The term styloid was, however, preferred in place of third valvula. Styloids are very well developed in Reduviidae and show varying complexity and specialization in its diverse subfamilies. The sclerites in connection with them have been named here according to their position and structure. Sclerites present on styloids have been termed styloid sclerites (Figs. 3, 6, etc. SST_1, SST_2) and are numbered consecutively. The membrane in between the styloids has been called interstyloidal membrane (Fig. 3, etc., INT.ST.MN) while the sclerites present on this membrane have been termed the inter-styloidal sclerites (Fig. 6 etc. INT.ST.S).

The term apodeme as used in the present work in connection with second valvifers and ninth paratergites is after DAVIS (1955). The apodeme present on ninth paratergite has been termed the tergal apodeme.

Male genitalia

The terminology as elucidated by DUPUIS and CARVALHO (1956) has largely been employed for male external genitalia and needs no repetition. However, a few new terms or terms used less frequently in literature desire explanation here.

In most Reduviidae examined, there opens into the basal foramen a sac-like structure (Basal plate sac, B.P.SC, Fig. 24 etc.), by a stalk (Basal plate stalk, SK.SC, Fig. 24 etc.). This appears to be a chitinous structure in as much as it can withstand the affect of KOH and glacial acetic acid.

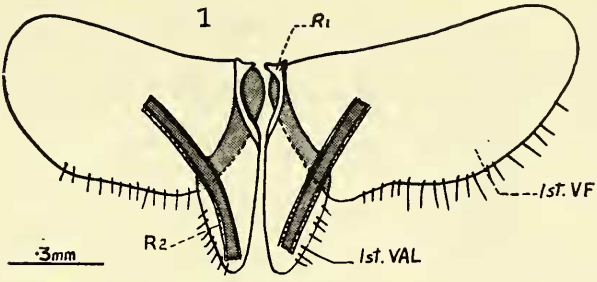
The term strut as used in the present work is after PRUTHI (1925) and DAVIS (1957). Struts are rod-like sclerites attached to the distal end of basal plates and extending through a part or the whole of the phallus.

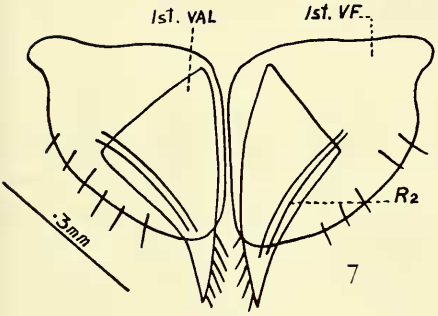
Endosoma contains certain sclerites called endosomal sclerites ('phanares' of VILLIERS, 1948). Present work shows that they fall into three categories as follows:

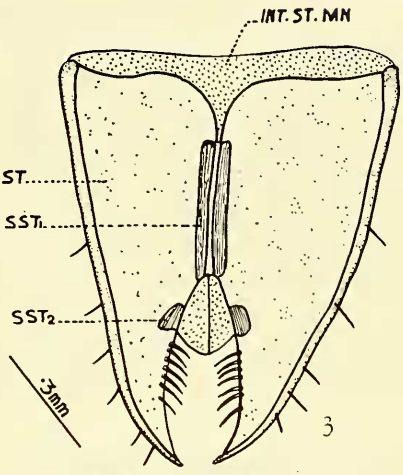
(i) 'a' type — These are completely sclerotized pieces that are devoid of any markings or coloration. The extent of sclerotization of the sclerites is of the same intensity as that of the ventral phallothecal wall. These sclerites appear to be derived from the wall of phallotheca but they could be highly specialized 'c' type sclerites as well.

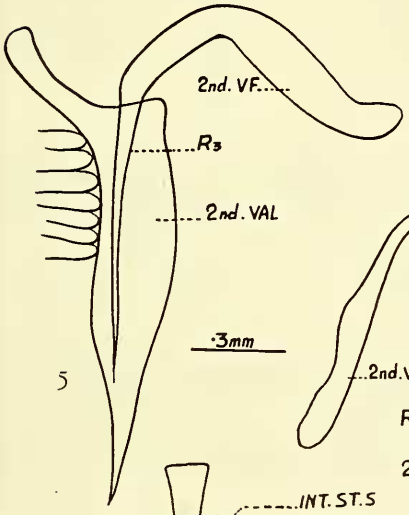
(ii) 'b' type — They are formed by the organization of the endosoma into distinct stiff pieces which still retain their continuity with the endosoma.

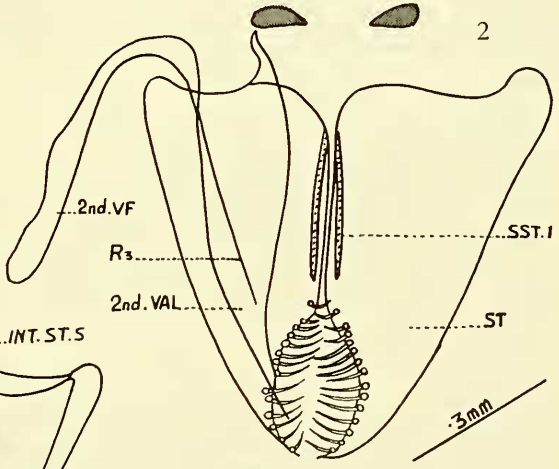
Figs. 1—2. *Pirates strepitans* Ramb. (Piratinae). 1. First valvifer and valvula; 2. Second valvifer, second valvula and styloids. Fig. 3. *Ectomocoris cordiger* Stål (Piratinae), styloids. Figs. 4—6. *Ectomocoris biguttulus* Stål. 4. First und 5. Second valvifers and associated parts. 6. Styloids. Fig. 7. *Oncocephalus impudicus* Ramb. First valvifer and associated structures.

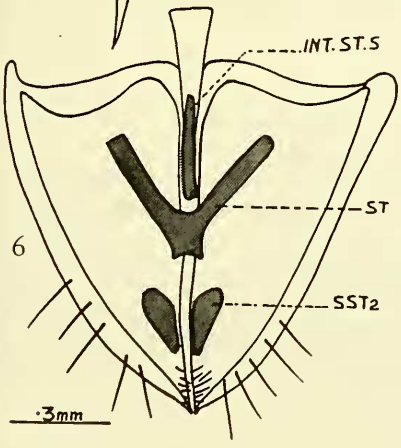

1
R1
1st. VF
R2
1st. VAL
·3mm

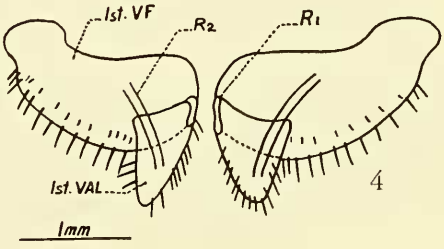

1st. VAL
1st. VF
R2
·3mm
7


INT. ST. MN
ST
SST1
SST2
·3mm
3


2nd. VF
R3
2nd. VAL
·3mm
5


2
2nd. VF
R3
2nd. VAL
SST1
ST
·3mm


INT. ST. S
ST
SST2
·3mm
6


1st. VF
R2
R1
1st. VAL
1mm
4

(iii) 'c' type — They appear to be modified form of 'b' type sclerites which seem to have lost their continuity with endosoma and have become highly sclerotized. They are always provided with tubercles and short spines.

SPECIAL PART

REDUVIOIDEA

REDUVIIDAE

Ovipositor

Piratinae.

Pirates strepitans Ramb. (Figs. 1, 2).

First valvifers large and strongly hairy on the lower side (Fig. 1); first valvulae U-shaped, outer ramus strong, well-developed and curved, inner ramus long and strongly ridged; second valvulae triangular and extremely long, their outer margins produced forwards and upwards, ramus of second valvulae long; second valvifers long, slender, curved proximally, styloids elongated, very broad proximally and gradually tapering distally, a pair of long cylindrical sclerotizations (SST_1) present on the styloids (Fig. 2); space between distal ends of styloids occupied by interlocking hairs, styloids joined for a greater part of their length through an interstyloidal membrane; a pair of triangular sclerotizations present on the vaginal wall above the styloids.

Ectomocoris cordiger Stål (Fig. 3).

Similar to *P. strepitans*, but an additional second pair of sclerotizations (SST_2) present on the styloids (Fig. 3), hairs between distal ends few and not interlocking.

E. biguttulus Stål (Figs. 4, 5, 6).

Similar to *P. strepitans* and *E. cordiger*, but shape of first valvifers different (Fig. 4); opposite margins of second valvulae bear long hairy projections (Fig. 5); an inter-styloidal sclerite present proximally, an Y-shaped styloidal sclerite present at about the middle (perhaps corresponding with SST_1 of *P. strepitans* and *E. cordiger*); a pair of drop-shaped sclerites (SST_2) present distally, hairs at distal ends small and few.

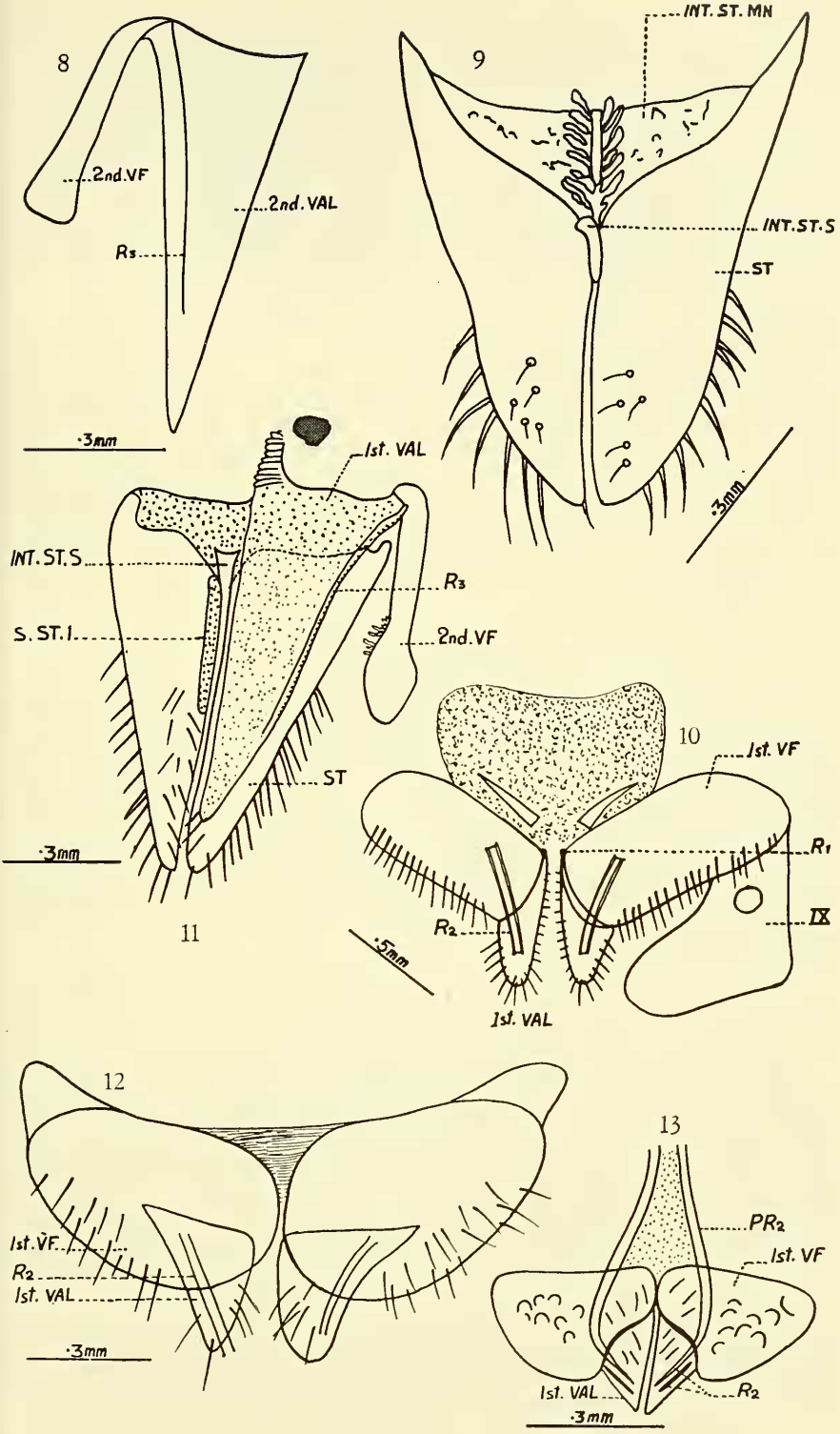
Stenopodinae.

Oncocephalus impudicus Ramb. (Figs. 7, 8, 9).

First valvifers somewhat sac-like and hairy, their anterior margins produced into an apodeme (Fig. 7); first valvulae long, triangular and attached by mem-

---

Figs. 8—9. *Oncocephalus impudicus* Ramb. (Stenopodinae). 8. Second valvifer and associated parts; 9. Styloids. Figs. 10—11. *Acanthaspis flavipes* Stål (Reduviinae). 10. First and 11. Second valvifer and associated structures. Fig. 12. *Reduvius cilatus* B. Jac. (Reduviinae). First valvifer and associated parts. Fig. 13. *Coranus aegypticus* Fabr. (Harpactorinae). First valvifer etc.


8
2nd.VF
2nd.VAL
Rs
·3mm
9
INT. ST. MN
INT.ST.S
ST
·3mm
1st. VAL
INT. ST. S
R3
S. ST. I
2nd.VF
ST
·3mm
11
10
1st. VF
R1
IX
R2
·5mm
1st. VAL
12
1st.VF
R2
1st. VAL
·3mm
13
PR2
1st. VF
1st. VAL
R2
·3mm

branes to the first valvifers, no outer ramus; second valvulae greatly elongated and triangular, as in Piratinae, inner ramus straight and long; second valvifers small, straight and club-like distally (Fig. 8); styloids, huge structures, very broad and round distally, not pointed (cf. Piratinae), anterior margin of styloids produced into a long apodeme-like process, small interstyloidal sclerite present distally, styloidal sclerites lacking, no hairs between the opposing distal ends of styloids, but hairs on the outer distal ends long and curved, a tree-like growth present in the interstyloidal membrane proximally (Fig. 9); styloids fused through an interstyloidal membrane anteriorly, but free posteriorly.

Reduviinae.

Acanthaspis flavipes Stål (Figs. 10, 11).

First valvifers large, U-shaped and bearing hairs over a smaller portion of the lower margin (cf. Piratinae); a pair of long triangular sclerites present in the vaginal wall above the first valvifers; first valvulae similar to Piratinae, outer ramus of first valvula knob-like; second valvulae (Fig. 11) sclerotized and similar to those of Piratinae; second valvifers straight like in Stenopodinae, elongate and slender proximally but club-like distally, the latter bearing a few small tubercles; styloids as in preceding cases, interstyloidal sclerite small, styloidal sclerite (SST_1) present (Fig. 11).

Reduvius cilatus B. Jac. (Figs. 12, 14).

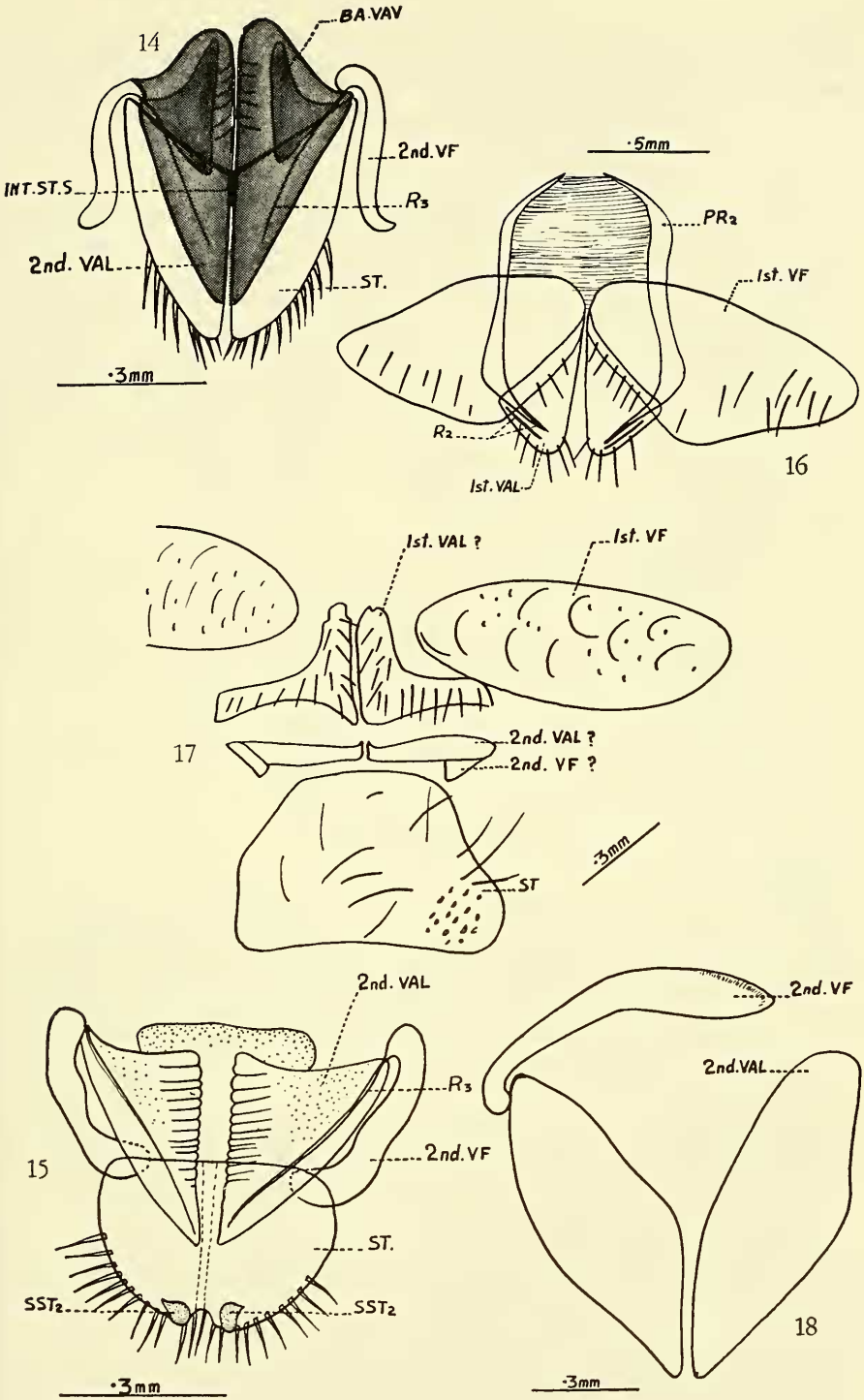
First valvifers large, ovoid, their anterior margins produced into an apodeme; first valvulae as in preceding cases, outer ramus absent; first valvifers held together by an intervalviferal membrane; second valvulae round proximally but tapering distally, they bear a triangular sclerite, the basivalvula (Fig. 12); second valvifers small and curved; styloids as in *Acanthaspis,* but much smaller; an Y-shaped interstyloidal sclerite (Fig. 14), apparently similar to that of *E. biguttulus,* is present; thick hairs present on the outer side of distal region but wanting on the inner, styloids free except anteriorly, where the Y-shaped interstyloidal sclerite holds them.

Harpactorinae.

Coranus aegypticus Fabr. (Figs. 13, 15).

First valvifers characteristically shaped and bearing many curved hairs; first valvulae triangular and without an outer ramus, outer edge of inner ramus greatly elongate and extending beyond the first valvifers into the vaginal wall, the space between these extensions completed by a soft transparent membrane; second valvulae triangular, membranous, transparent, and bearing characteristic annulations on the opposite margins; the space between the opposing second valvulae occupied by a slightly folded transparent intervalvular membrane; second

Fig. 14. *Reduvius cilatus* B. Jac. Second valvifer and associated structures. Fig. 15. The same, of *Coranus aegypticus* Fabr. Figs. 16 and 18. *Gminatus* sp. (Harpactorinae), 16 First, and 18. Second valvifer, etc. Fig. 17. *Opisthoplatys australasiae* Westwood (Tribelocephalinae): Ovipositor spread out, first valvifers on left side incompletely shown.


14
BA.VAV
2nd.VF
INT.ST.S
R3
2nd. VAL
ST.
·3mm
·5mm
PR2
1st. VF
R2
1st. VAL
16
1st. VAL ?
1st. VF
17
2nd. VAL ?
2nd. VF ?
·3mm
ST
2nd. VAL
R3
2nd.VF
15
ST.
SST2
SST2
·3mm
2nd.VF
2nd.VAL
18
·3mm

valvifers curved and gaining attachment to the second valvulae by the straight ramus of the latter; styloids fused into a single piece; two vertical sutures in the central region present which indicates that styloids of opposite sides are fused; a pair of styloidal sclerites and numerous hairs present distally.

Gminatus sp. (Figs. 16, 18, 19).

First valvifers petal-shaped and devoid of hairs on the lower margin (cf. *C. aegypticus*); first valvulae somewhat U-shaped, outer margin of the inner ramus prolonged beyond the first valvifer into the vaginal wall as in Stenopodinae; the portion between the opposite valvifers completed by a membrane; second valvulae very broad, particularly so in the middle region; no trace of rami in any valvulae; second valvifers club-like (Fig. 19) and slightly bent in the middle (shown in the diagram in the opposite direction) beset with small tubercles; styloids greatly reduced in comparison to other Reduvioidea, being simple, slender curved rods, held together by a well-developed interstyloidal membrane (Fig. 18).

Tribelocephalinae.

Opisthoplatys australasiae West (Fig. 17).

First valvifers large, discoidal, beset with curved hairs and numerous small tubercles; the first valvulae appear to be represented by a pair of strongly sclerotized hairy pieces, bent at right angles; second valvulae slender and rod-like; second valvifers appear to be represented by very small pieces at the base of the second valvulae, first and second valvulae devoid of any rami; styloids fused (fuse not distinct) and covered with hairs and tubercles here and there.

The interpretation of the first and second valvulae and the second valvifers, as presented here, is based on the study of a single specimen.

External male genitalia

Piratinae.

Ectomocoris biguttulus Stål (Figs. 20, 21).

Basal plates short, their two arms jointed by a basal plate bridge at their apices; basal plate sac present; the struts completely fused with each other and with the ventral phallothecal wall, and extending over two thirds of the length of phallus; ventral wall of phallotheca highly sclerotized, dorsal and lateral walls membranous; two endosomal sclerites of 'a' type, three of 'b' type and a pair of 'c' type present.

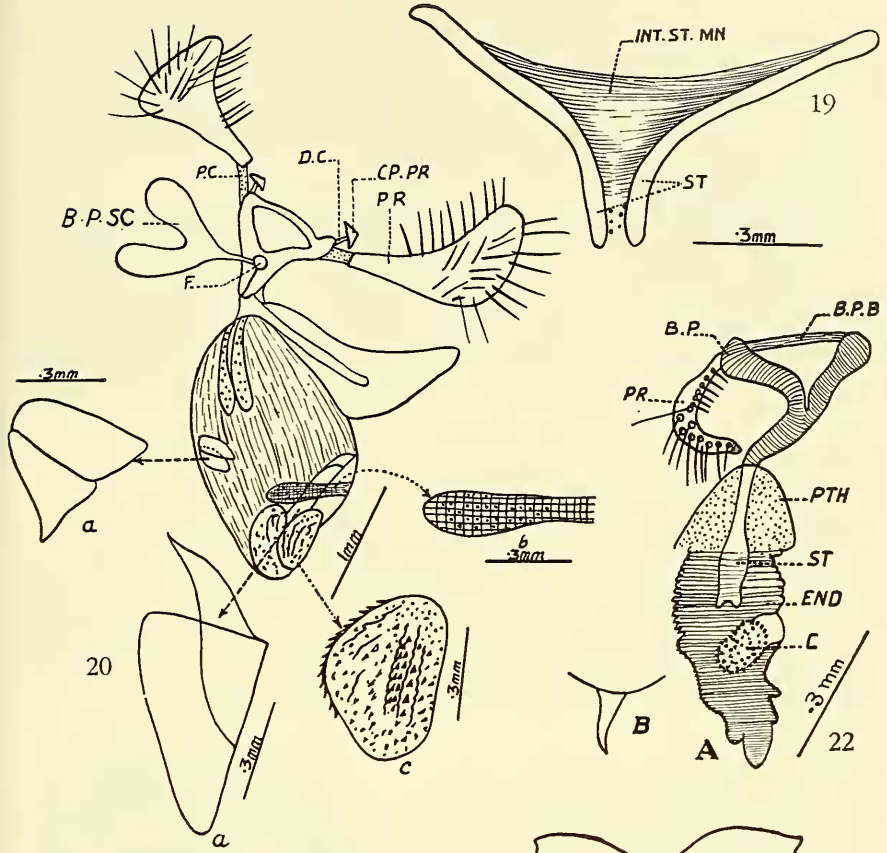
Parameres flattened and densely hairy; similar parameres have been figured by VILLIERS (1948) in *E. dichorous* Stål; eighth segment produced into a short spine at about its middle while the ninth has a very big flat central spine.

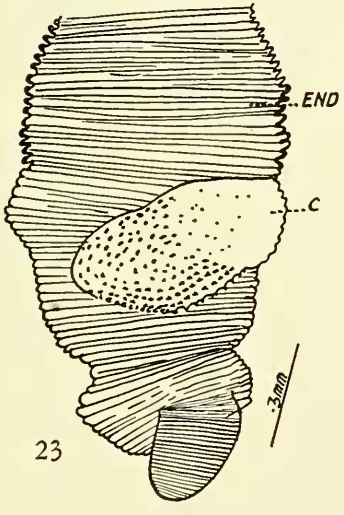
E. cordiger Stål (Fig. 24).

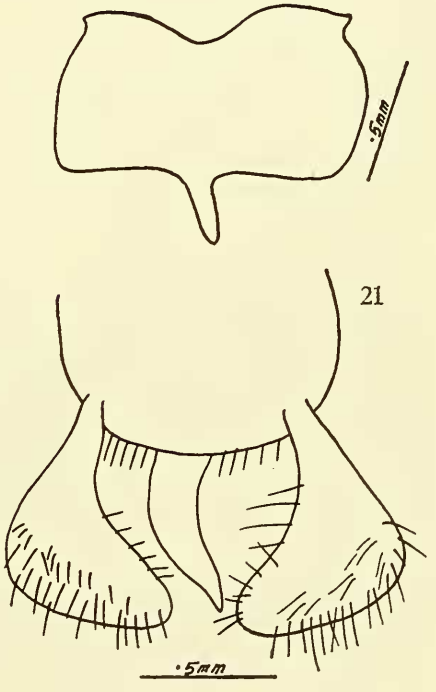
Basal plates similar to those in *Ectomocoris*, but their arms longer and stouter,

---

Fig. 19. *Gminatus* sp. (Harpactorinae). Styloids. Figs. 20—21. *Ectomocoris biguttulus* Stål. 20. Aedeagus and associated parts (endosomal sclerites separated out); 21. Eighth sternite and pygophore. Figs. 22—23. *Acanthaspis flavipes* Stål. (Reduviidae). 26. A. Aedeagus and parameres, B. Pygophoral spine; 27. Endosoma, dissected.


INT. ST. MN
19
ST
·3mm
P.C.
D.C.
CP. PR
P.R
B.P.SC
F.
·3mm
a
1mm
b
·3mm
20
·3mm
a
·3mm
c
B.P.B
B.P.
PR
PTH
ST
END
C
·3mm
B
A
22


END
C
·3mm
23


·5mm
21
·5mm

basal plate sac large and flattened, basal plate strut single, hardly dilated, and flattened, perhaps representing two fused struts; phallotheca highly sclerotized, endosoma has one 'a' type and two 'c' type sclerites, those of 'b' type are missing; parameres similar to *E. cordiger*, but proximal portion much reduced; eighth segment and pygophore as in *E. biguttulus*.

Pirates strepitans Ramb. (Fig. 27).

Basal plates and struts similar to *E. cordiger* but both much larger in comparison to the latter, basal plate sac not observed in the two specimens examined; it might have been missed; phallotheca highly sclerotized; endosoma greatly folded and bearing two pairs of 'a' type and one pair of 'c' type sclerites; eighth segment and pygophore similar to the preceding *Ectomocoris* species, but spines small.

Stenopodinae.

Oncocephalus impudicus Rent. (Fig. 28).

Basal plates short, flattened at the apices but fused ventrally and continued distally into a long process which reaches the phallothecal surface, basal plate bridge present near the apices; struts long, free and continued to the distal end of the phallus; phallotheca membranous and sclerotized on the lateral sides; endosoma presents many folds but is devoid of any sclerites; parameres long and straight in the proximal, but curved and hairy in the distal region.

Reduviinae.

Acanthaspis sexguttatus Fabr. (Fig. 29).

Arms of basal plates small and fused into a curved distal portion, basal plate bridge and basal plate sac present; two struts S_1 and S_2 reaching the distal end of the phallus present; one 'c' type endosomal sclerite present; two strong, well-developed and highly sclerotized endosomal processes present; similar processes were not noted in any other Reduviid species, although a pair of weak endosomal processes have been figured by CARAYON, USINGER and WYGODZINSKY (1958); parameres hook-like but more curved and densely hairy.

Acanthaspis flavipes Stål (Figs. 22, 23),

Basal plates as in *A. sexguttatus* but much stouter, basal plate sac not observed; phallotheca highly sclerotized; basal plate struts small and not extending beyond the middle of the phallotheca; endosoma stiff, having a definite shape (Fig. 23) and presenting no folds whatever, much similar to that in Harpactorinae, but less stiff in comparison; one 'c' type endosomal sclerite present; parameres sickle-shaped; pygophore bears a small central spine, as in Piratinae.

The great dissimilarity in the structure of the male genitalia of two species of *Acanthaspis* is not easy to understand; the latter species may have been erroneously identified.

Reduvius cilatus B. Jac. (Figs. 25, 26, 30, 31).

Basal plates very long and curved, basal plate bridge present; struts paired,

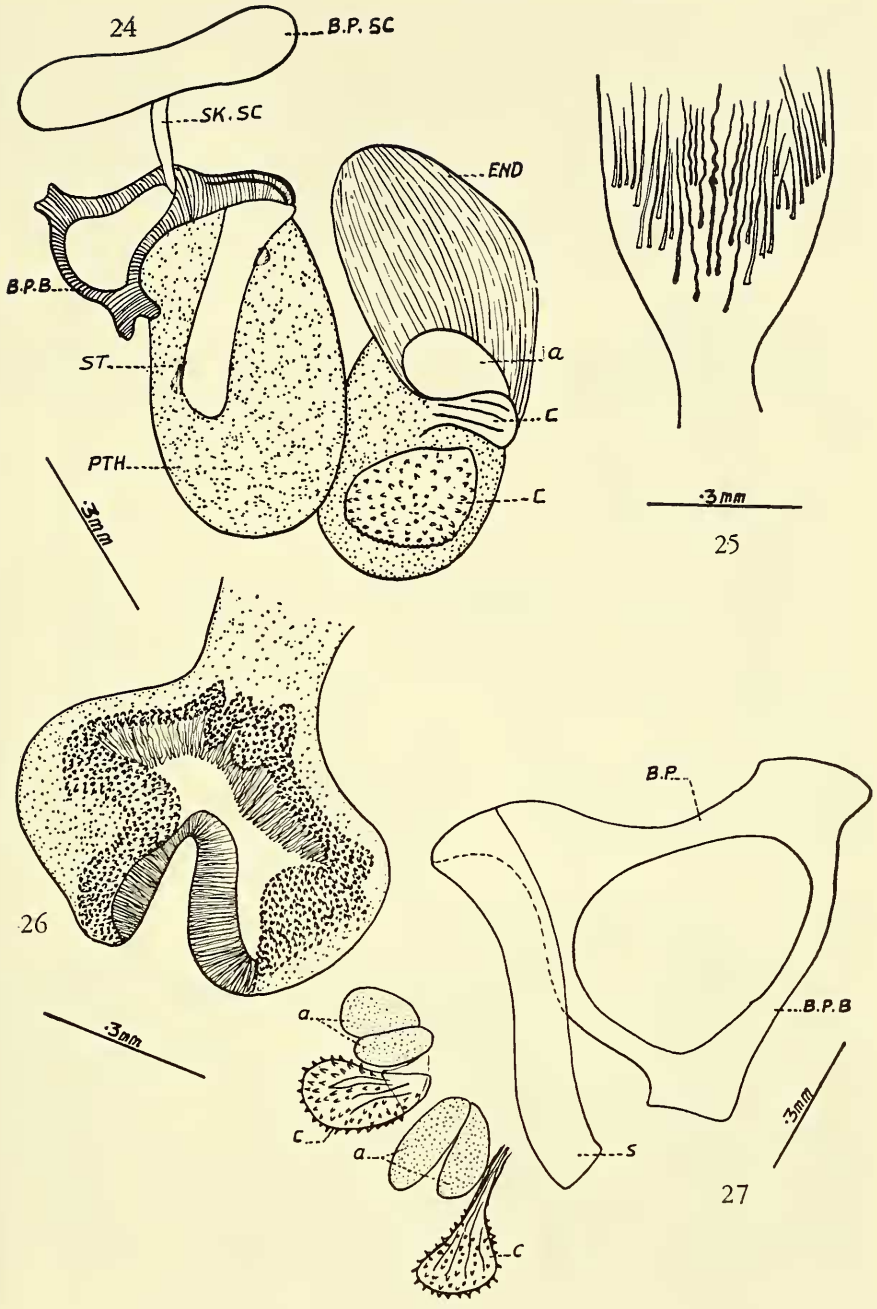


Fig. 24. Aedeagus of *E. cordiger* Stål (Piratinae), Endosoma removed from phallotheca. Fig. 25—26. *Redivius cilatus* B. Jac. 25. Phallothecal wall. 26. Endosoma, dissected. Fig. 27. Basal plates, struts and endosomal sclerites of *Pirates strepitans* Ramb. (Piratinae).

closely pressed to each other, but separable with sufficient care, round and flat at the distal ends and fused with the ventral wall of phallus; basal plate sac with a well developed stalk present; phallotheca higly sclerotized, its dorsal wall marked with brownish striations (Fig. 25), these being thick in the middle, but becoming thinner on the sides; endosoma although appearing in the form of a compact capsule, in fact, deeply folded (Fig. 26), dull grey in colour and marked with black tubercles in the distal region; pygophore bears a central spine but the eighth sternum is devoid of any such spines; parameres long and curved in the distal region, the latter bearing many hairs.

Reduvius spec.

Almost similar to *R. cilatus,* but endosoma much less developed in comparison to the latter, devoid of any tubercles, yellowish with a blackish patch towards the centre.

Harpactorinae.

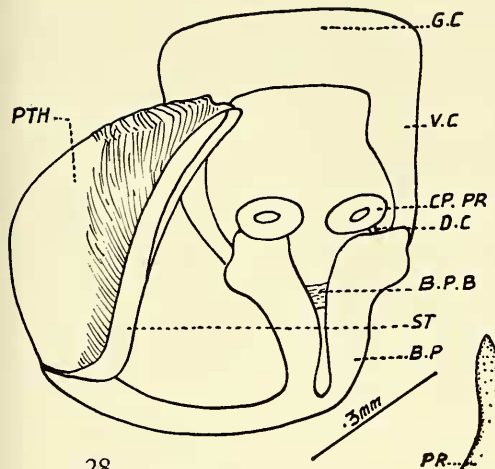
Coranus aegypticus Fabr. (Figs. 32, 33).

Basal plates very long and curved, fused ventrally and continued distally into a long shaft which reaches the surface of the phallotheca; a pair of short struts intimately fused with the phallothecal wall, but separated from each other by a wide gap (compare the preceding cases where the struts are so close as to be indistinguishable); struts restricted only to basal region of phallus; phallotheca bulb-like and sclerotized at places (Fig. 33); endosoma highly sclerotized and containing one pair of 'a' type, two pairs of 'b' type and one pair of 'c' type sclerites; endosoma extremely stiff; it may be removed as a whole from the phallotheca; parameres strongly hairy and flattened at apices; pygophore bears a pair of characteristic spines.

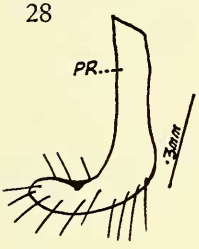
Rhinocoris fuscipes Fabr. (Figs. 34, 35).

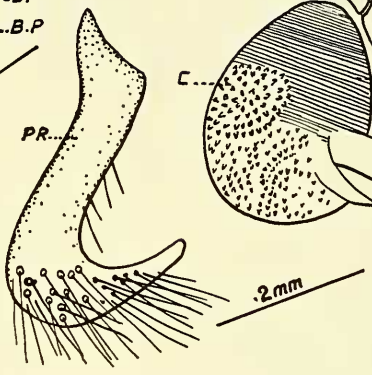
Basal plates deeply curved, struts separated by a gap as in *Coranus aegypticus* but extend to the middle of the phallotheca; phallotheca marked with many thick processes, its outline very thick, strongly sclerotized and produced into characteristic processes at the sides (Fig. 34); endosoma extends beyond the phallotheca and contains three 'a' type sclerites, two of them in the distal region being paired; the unpaired third sclerite may be readily recognized as a giant piece with two pairs of strongly sclerotized processes; five 'c' type sclerites are present, four of them being paired, fifth unpaired; besides, a pair of long curved sclerites of unknown homology may be seen in the anterior region (Fig. 35); central spine of pygophore flattened and grooved at the tip; parameres curved, club-like and hairy in the distal region.

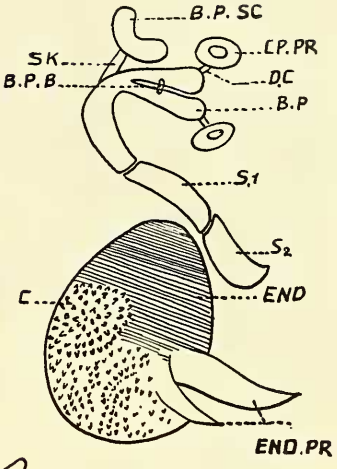
Fig. 28. Aedeagus and paramere of *Oncocephalus impudicus* Rent (Stenopodinae). Fig. 29. Aedeagus and paramere of *Acanthaspis sexguttatus* Fabr. (Reduviinae). Fig. 30—31. *Reduvius cilatus* B. Jac. 30. Struts and phallotheca. 31. A. Aedoagus and associated parts. B. Pygophoral spine.


G.C
PTH
V.C
CP. PR
D.C
B.P.B
ST
B.P
.3mm

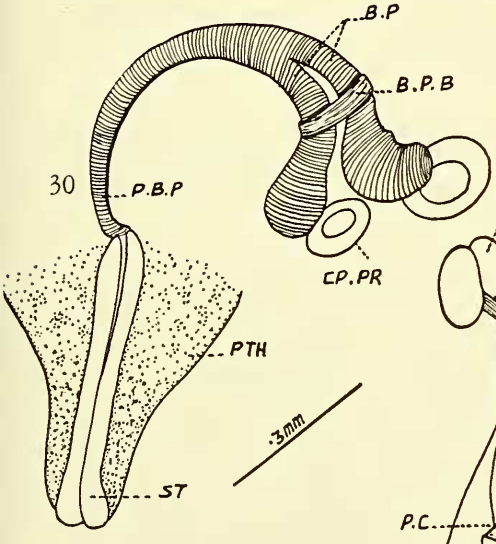
28

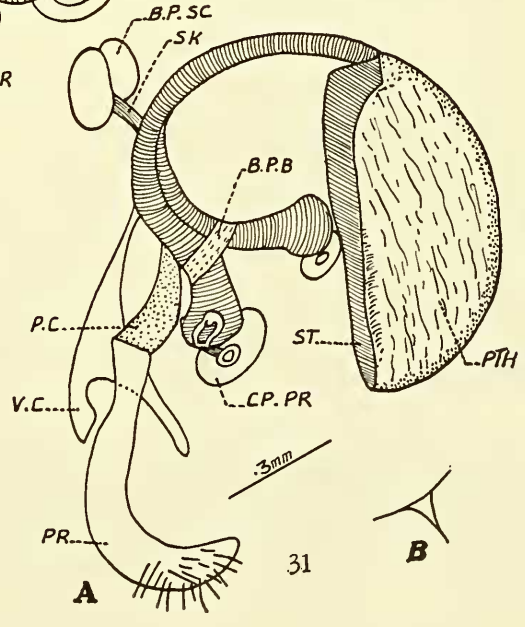

PR
.3mm


PR
.2mm


B.P. SC
SK
CP. PR
B.P.B
D.C
B.P
S1
S2
C
END
END.PR

29


B.P
B.P.B
30
P.B.P
CP.PR
PTH
.3mm
ST


B.P.SC
SK
B.P.B
P.C
ST
PTH
V.C
CP. PR
.3mm
PR
A
31
B

VILLIERS (1948) figured aedeagi of several Harpactorinae; his diagrams of phallotheca are very similar to those described in the present paper. However, VILLIERS paid little attention to detailed study of endosomal sclerites.

Pseudospermathecae

Two pseudospermathecae are present in almost all Reduviidae, but SCUDDER (1959) states the presence of four in a species of *Petalochirus*. SCUDDER further suggests that pseudospermathecae could be of great value as a taxonomic character in various sub-families of Reduvioidea. This author evidently means the great variation in the shape exhibited by these structures. From the present studies and by a comparison of other papers it is felt that the shape of these spermathecae appears to vary from species to species, e.g., pseudospermathecae of *C. subapterus* as figured by PENDERGRAST (1957, Fig. 22, p. 10) with *Coranus aegypticus* (Fig. 37) of the present study; therefore, they might prove to be good specific characters. In the present work, spermathecae of three sub-families have been studied.

(i) Reduviinae: *Acanthaspis flavipes* Stål (Fig. 36). A pair of pseudospermathecae present.

(ii) Piratinae: *Ectomocoris cordiger* Stål (Fig. 38). Pseudospermathecae are interesting, for in this species the left pseudospermatheca is very long, with a globular apical bulb which is filled with dense black secretions, while the right is very small and club-like.

(iii) Harpactorinae: *Coranus aegypticus* (Fig. 37). Apical bulb flattened and oval with the spermathecal duct attached to it.

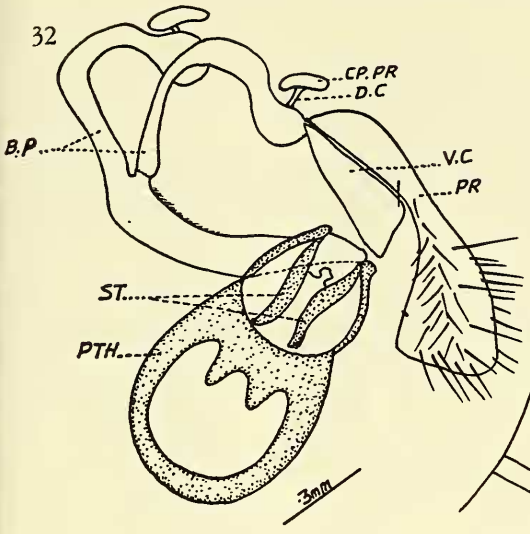
Rhinocoris fuscipes Fabr. (Fig. 39).

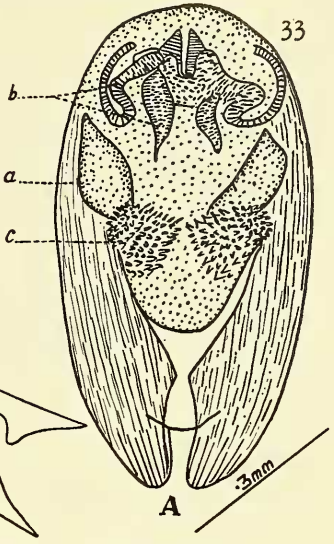
The ducts of pseudospermathecae long and curved; apical bulb globular; characteristic chitinous thickenings present between the two pseudospermathecae.

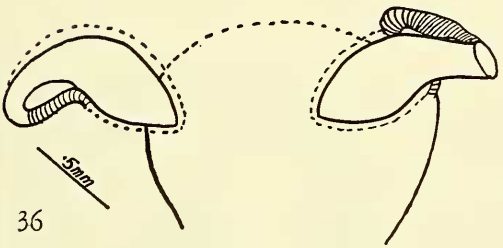
Internal male genitalia

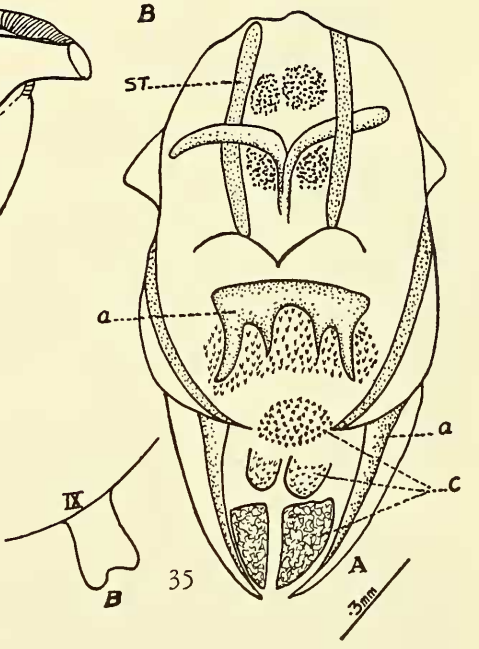
Internal male genitalia in most sub-families of the Reduviidae have been investigated by CARAYON (1944, 1950c), and by CARAYON, USINGER and WYGODZINSKY (1958); besides, there are descriptions by GALLIARD (1935) and PENDERGRAST (1957). In the present studies the male genitalia were investigated in two *Reduvius* species; and the general structure appeared to be in agreement with descriptions by these authors. The mesadenes are paired and each consists of "four lobes meeting centrally in a stellate fashion" (Fig. 40). Bulbus ejaculatorius though not apparent externally has the usual complex structure of the bulbus of land bugs (Fig. 41). Male reproductive organs are very uniform in different subfamilies of Reduviidae and do not appear to have much taxonomic value.

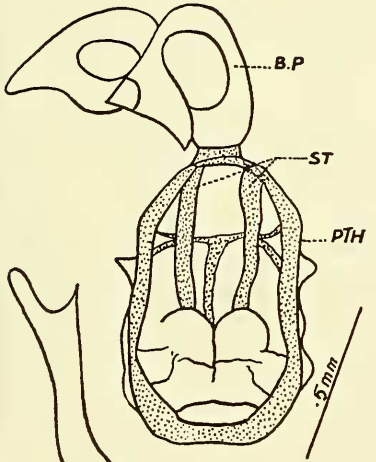
Figs. 32—33. *Coranus aegypticus* Fabr. (Harpactorinae). 32. Aedeagus and associated parts (endosoma removed); 33. A. Endosoma, B. Pygophoral spines. Figs. 34—35. *Rhinocoris fuscipes* Fabr. (Harpactorinae). 34. Aedeagus without endosoma; 35. A. Endosoma, B. Pygophoral spine. Figs. 36—37. Pseudospermathecae of 36. *Acanthaspis flavipes* Stål. 37. *Coranus aegypticus* Fabr.

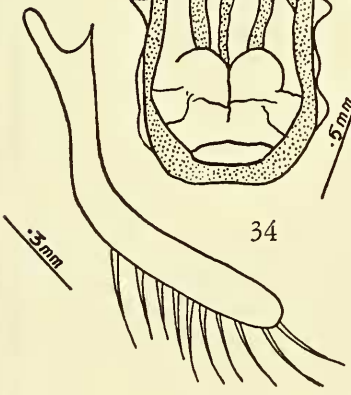

32
CP.PR
D.C
B.P
V.C
PR
ST.
PTH
.3mm

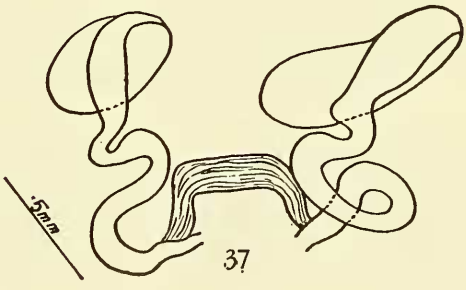

33
b
a
c
A
.3mm


.5mm
36


B
ST.
a
a
C
IX
B
A
35
.3mm


B.P
ST
PTH
.5mm
34


.3mm


.5mm
37

Salivary glands

Piratinae.

Pirates strepitans Ramb. (Fig. 44).

Principal gland bilobed, anterior lobe extremely reduced, posterior lobe very long; accessory salivary duct adpressed to the oesophagus and ends in a large vesicular swelling.

Ectomocoris cordiger Stål (Fig. 43) and *E. biguttulus.*

Anterior lobe longer than that of *P.strepitans* Ramb. posterior lobe extremely long; accessory salivary duct does not end in a vesicular swelling.

Stenopodinae.

Oncocephalus impudicus Ramb. (Fig. 42).

Anterior lobe very short, posterior lobe very long.

Harpactorinae.

Rhinocoris fuscipes Fabr. (Fig. 45).

Anterior lobe small, posterior lobe extremely long and very broad.

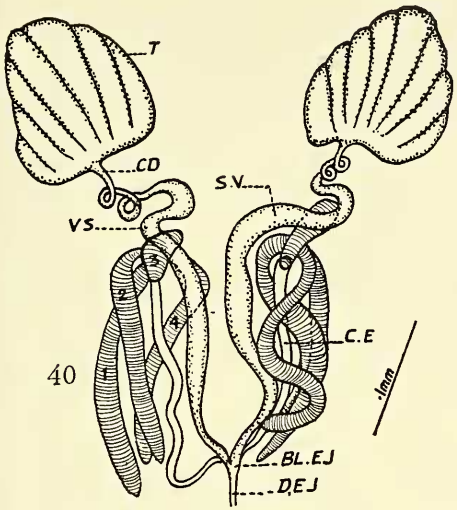
It is evident from the above account that salivary glands, like internal male genitalia show little variation. Anterior lobe is always very short, in some cases strongly reduced, in some divided into anterior and posterior lobes, and sometimes entirely lost as in *Rhodnius prolixus* Stål (SOUTHWOOD, 1956b). It has been pointed out by SOUTHWOOD (1956b) that in some Reduviidae a blind tube arises from the accessory gland and is adpressed to the mid gut. In the present study it was found that accessory salivary duct is adpressed to oesophagus and has become so intimate with the latter that it is difficult to separate. Posterior lobe in Reduviidae is always very long.

RELATIONSHIPS OF THE SUB-FAMILIES REDUVIINAE, PIRATINAE, STENOPODINAE, TRIATOMINAE, HARPACTORINAE AND TRIBELOCEPHALINAE

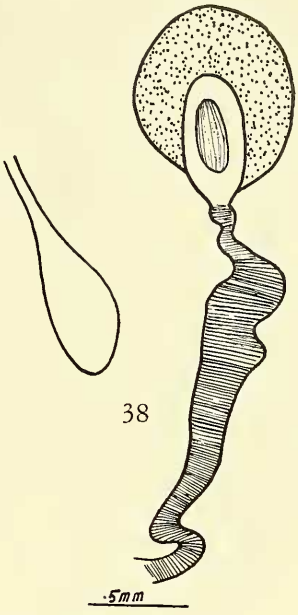
Considering the female external genitalia we find that Reduviinae, Piratinae and Stenopodinae are closely related. Piratinae are more specialized because in them there is a tendency towards the fusion of styloids, and the forming of more styloidal sclerites, these features reach their extreme in *Ectomocoris biguttulus.* Similarly when we take into consideration external male genitalia, we again find that Piratinae are most specialized of these three families, for, in them all the three types of endosomal sclerites (or "phanares" of VILLIERS, 1948) are present, the struts are fused and the pygophore has developed a very long consistent cen-

---

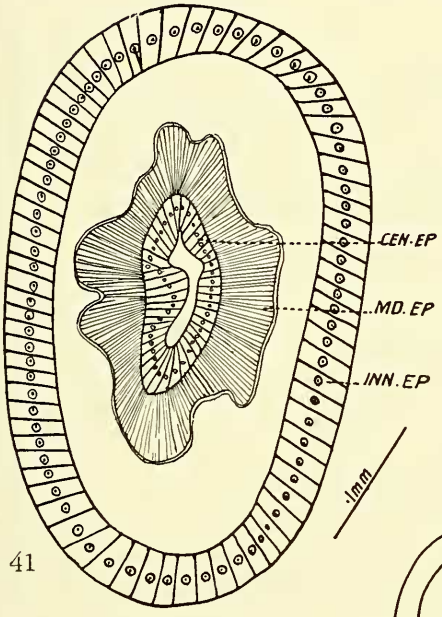
Figs. 38—39. Pseudospermathecae of: 38. *Ectomocoris cordiger* Stål. 39. *Rhinocoris fuscipes* Fabr. Fig. 40. Male reproductive organs of *Reduvius cilatus* B. Jac. (Reduviinae). Fig. 41. Transverse section through the bulbus ejaculatorius of *Ectomocoris biguttulus* (Piratinae). Figs. 42—43. Salivary glands. 42. *Oncocephalus impudicus* Ramb. 43. *Ectomocoris cordiger* Stål.



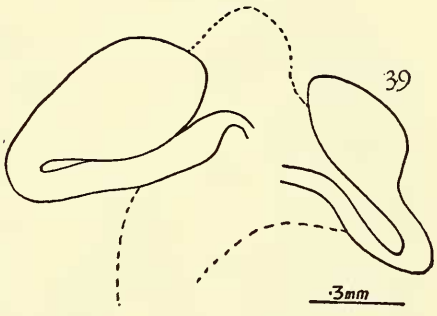
40



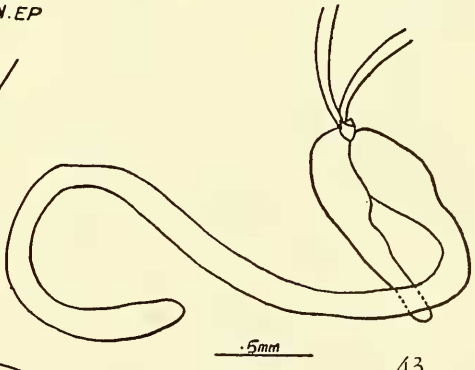
38



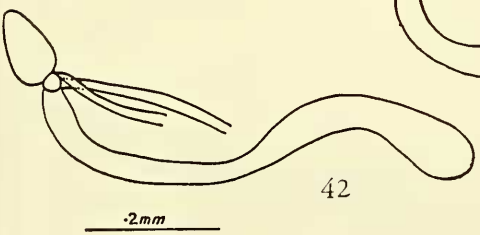
41



39



43



42

tral spine. Genus *Reduvius* is the least specialized, it has no endosomal sclerites and the struts are paired. Genus *Acanthaspis* shows close relation to Piratinae in having fused struts, development of stiff endosoma and endosomal sclerites.

SCUDDER (1959) mentions the fusion of second valvulae in *Rhodnius prolixus* Stål (Triatominae) and this figure (iFg. 43, page 434) shows that the inner proximal margin of each styloid is produced forward, as in Piratinae. Triatominae appear to show resemblances to Piratinae but the former are more advanced in having the second valvifers fused.

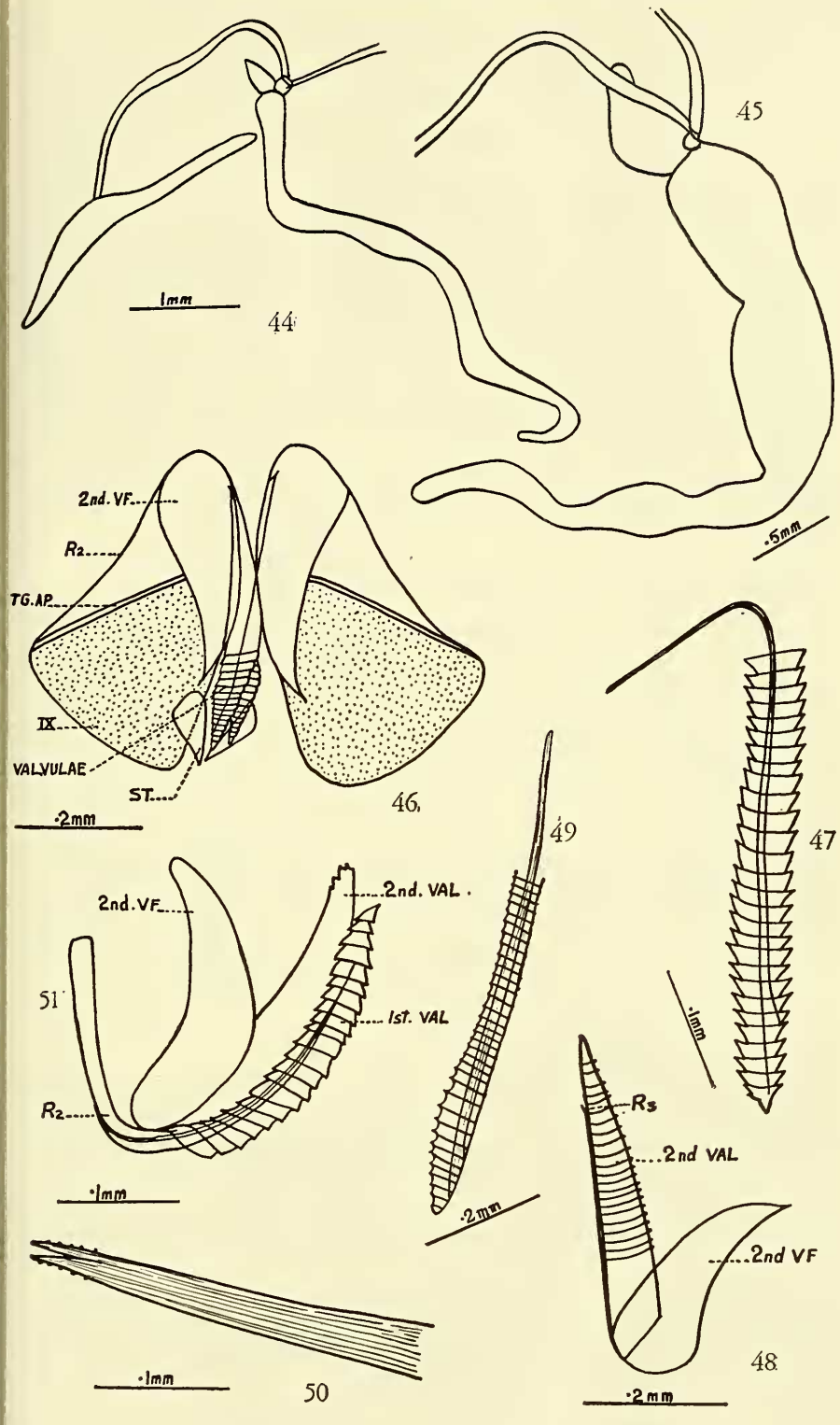
In Harpactorinae it may be seen that second valvulae and valvifers are on the same lines as in Reduviinae, Stenopodinae and Piratinae, but the styloids are fused into one compact structure and a further specialization is seen in the inner ramus of first valvula, the outer margins of which are greatly elongated, extending far beyond the first valvifers and high into the vaginal wall, and are joined by a membrane. SOUTHWOOD (1956a) noted that Stenopodinae showed similarities to Harpactorinae in the structure of eggs. Considering male external genitalia we find that Harpactorinae are very distinct in having characteristic phallotheca to which the struts have become inseparably fused. The endosoma in Harpactorinae is highly specialized, it is very stiff, strong and can be removed from the phallotheca without injury. Further, it has well developed endosomal sclerites, like in Piratinae, and the pygophore has a pair of spines. Harpactorinae would, therefore, appear to be highly specialized Piratinae.

Genus *Gminatus* amongst Harpactorinae shows great specialization in the loss of the ramus of second valvula and an extreme reduction of styloids. The styloids are held together by an interstyloidal membrane along their entire length.

Tribelocephalinae appear altogether distinct in having extremely reduced second valvifers, little developed second valvulae while there is no trace of any rami and the styloids are completely fused. In all these respects they form a very distinct group. Tribelocephalinae seem to approach Phymatidae at least in respect of the structure of the ovipositor. In Tribelocephalinae as said above, first and second valvulae are much reduced and devoid of any rami; the Phymatid condition might be a result of a further degeneration of these structures. They seem to be much more related to Carcinocorinae (as described by DAVIS, 1957) in this respect, where styloids are fused together and first and second valvulae are much reduced.

Therefore, one may conclude from the present study that the ovipositor and the male external genitalia can be used as very useful tools in the study of the interrelationships of various subfamilies of Reduviidae. A study of these structures along the lines, laid down in the present paper seems highly desirable.

Figs. 44—45. Salivary glands. 44. *Pirates strepitans* Ramb. 45. *Rhinocoris fuscipes* Fabr. Figs. 46—48. *Galeatus scrophicus* (Saunders). 46. Ovipositor dorsal view; 47. First valvula; 48. Second valvifer and valvula. Figs. 49—50. *Paracopium cingalensis* (Walker). 49. First valvula; 50. Second valvulae. Fig. 51. First and second valvula and second valvifers of *Dictyla* sp.


1mm
44
45
·5mm
2nd. VF
R2
TG.AP
IX
VALVULAE
ST
·2mm
46
49
47
·1mm
2nd. VF
2nd. VAL.
51
1st. VAL
R2
·1mm
R3
2nd VAL
·2mm
2nd VF
48
·2mm
·1mm
50

External female genitalia

TINGOIDEA

TINGIDAE

Galeatus scrophicus (Saunders) (Figs. 46, 47, 48).

First valvifer fused with eighth paratergite; first valvulae long and more or less of a uniform size; when examined under high magnification they prove to be divided by transverse lines into definite annulations (Fig. 47); but when these valvulae are examined under low magnification they appear to consist of only small teeth on the upper and lower margins; ramus of first valvula long, curved and joining the tergal apodeme of the ninth paratergite; second valvulae elongate, wedged-shaped and divided into many annulations (Fig. 48); second valvifer small, plate-like, very broad proximally, narrow distally and jointed to the second valvulae by an arcuate ramus; styloids triangular and their concave mesal surfaces enclosing the distal portion of the shaft of ovipositor (Fig. 48); tergal apodeme well-developed; valviferal apodeme weakly developed.

Paracopium cingalensis (Walker) (Figs. 49, 50).

First valvifer fused with eighth paratergite; first valvula long, cylindrical and annulated (Fig. 49); second valvulae fused together except their distal ends which are free (Fig. 50), a few tooth-like projections present on their upper distal surfaces; second valvifers round in the natural position; the tergal apodeme protrudes deeply into the second valvifer and pushes the outer surface of the latter far towards the inner side; styloids present.

Dictyla spec. (Fig. 51).

Similar to *Galeatus* but the annulations on the first valvulae are broader and the second valvulae bear some teeth on their upper margins.

CIMICOIDEA

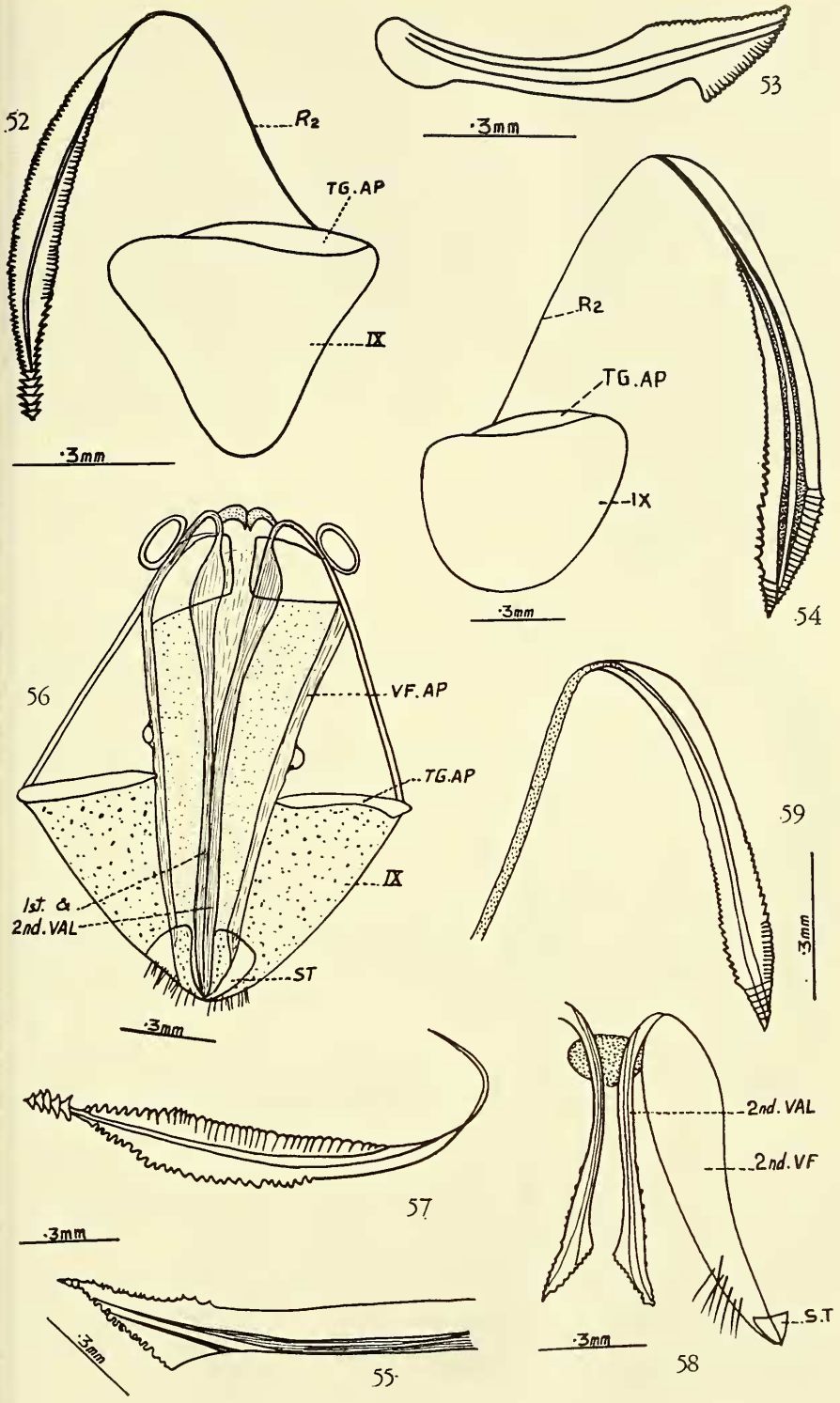
MIRIDAE

Polymerus capitatus Dist. (Figs. 52, 53).

First valvifers fused with eighth paratergites; first valvulae long, lanceolate, and bearing teeth along their entire length on both upper and lower margins; these teeth more pronounced towards the tip; the tip divided into annulations, like in Tingidae, but the number of annulations is limited; first valvulae provided with a strong ridge and joined to the tergal apodeme by an arcuate ramus, as in Tingidae; second valvulae much more sclerotized in comparison with first valvulae,

---

Figs. 52—53. *Polymerus capitatus* Dist. 52. First, and 53. Second valvula. *Polymerus* sp. probably *consanguiensis*. 54. First, and 55. Second valvula; 56. Ovipositor, dorsal view. Figs. 57—58. *Lygus decoloratus*. 57. First, and 58. Second valvula. Fig. 59. *Helopeltis theivora*. First valvula.


52
R2
TG.AP
IX
·3mm
53
·3mm
R2
TG.AP
IX
·3mm
54
56
VF.AP
TG.AP
IX
1st. &
2nd. VAL
ST
·3mm
59
·3mm
57
·3mm
2nd. VAL
2nd. VF
S.T
·3mm
58
·3mm
55

distal portions of second valvulae wedge-like and bearing numerous teeth, but not completely annulated; a ridge present in the second valvula; second valvulae fused at their bases; second valvifers Tingid-like, broad proximally and narrowing distally; styloids present.

Polymerus spec., probably *consanguiensis* (Figs. 54, 55, 56).

First valvulae lanceolate, teeth on the upper margins extend throughout its length in the form of slight indentations while on the lower margin they are restricted distally (Fig. 54), a median groove present in the valvulae, tip of the valvulae distinctly annulated; second valvulae highly sclerotized and of characteristic shape (Fig. 56); they bear a groove and numerous teeth-like projections towards the apical portion; second valvifers slightly hairy, very broad anteriorly but narrowing posteriorly (Fig. 55); styloids present; tergal apodeme present; proximally of the insertion of tergal apodeme a ring-like structure of unknown significance may be discerned (Fig. 56).

Lygus decoloratus (Figs. 57, 58).

Similar to *P. capitatus*.

Helopeltis theivora (Figs. 59, 60).

Very much like *P. consanguiensis*, first valvulae as in *P. consanguiensis*, but the tooth-like indentations extend also on the lower margins and tooth-like projections of second valvulae are more pronounced; the second valvifers are devoid of hairs.

DAVIS (1957) did not notice the presence of a ridge in the first valvula of Miridae; such a ridge is present indeed.

Nabidae.

Nabis tibialis (Figs. 61, 62, 63).

First valvifers long (Fig. 61); first valvula long, cylindrical and annulated along its entire length, as in Tingidae (Fig. 62); second valvulae bear characteristic sagittate markings on their lower margins (Fig. 63), upper margins devoid of any teeth (cf. Tingidae); second valvulae not fused basally (cf. Miridae); styloids present.

External male genitalia

TINGOIDEA

TINGIDAE

Galeatus scrophicus (Fig. 64).

Basal plates U-shaped; phallotheca slightly sclerotized; endosoma of more or less uniform breadth, an arch-shaped sclerite present in the basal region; a pair of endosomal processes present in the distal region; vesica cannot be made out; paramere figured, broad in proximal and narrow in distal region.

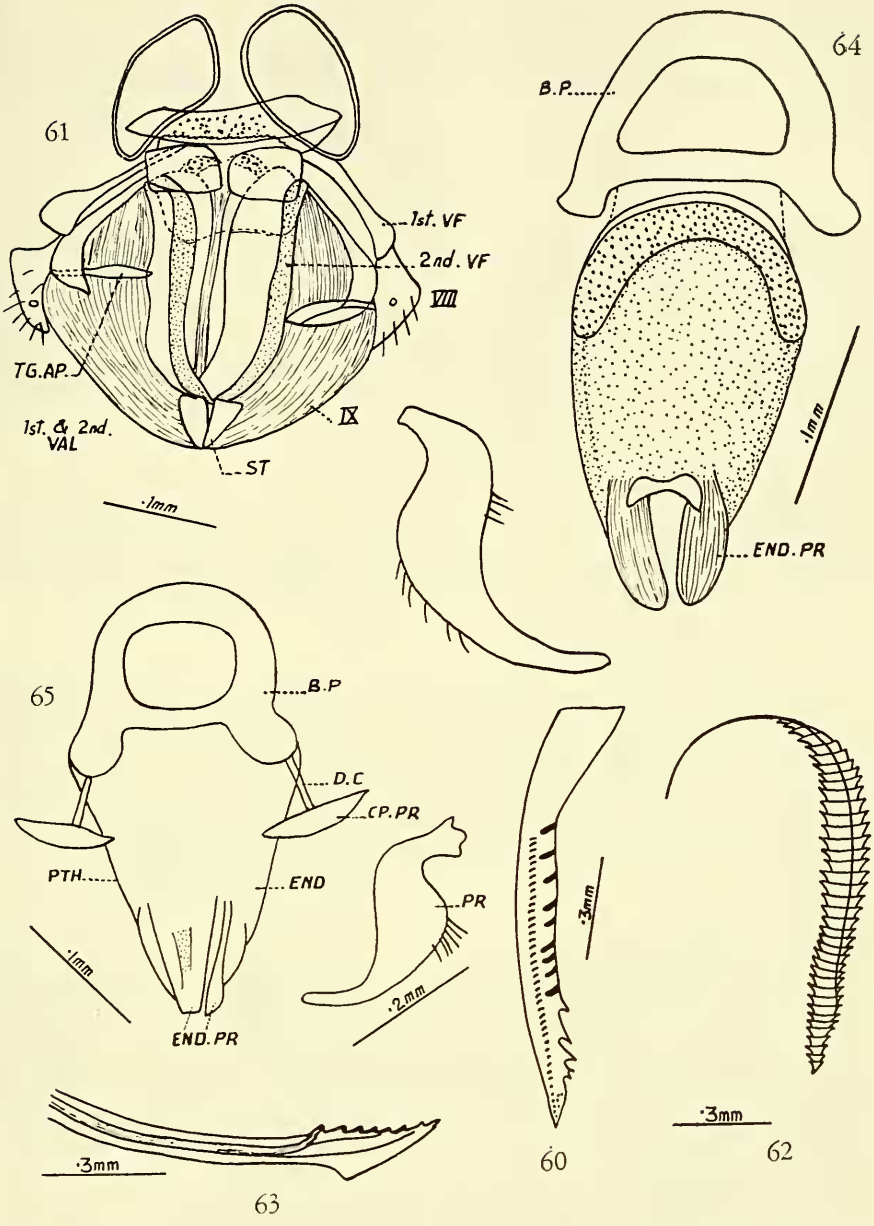


Fig. 60. *Helopeltis theivora.* Second valvula. Figs. 61—63. *Nabis tibialis.* 61. Ovipositor dorsal view; 62. First, and 63. Second valvula. Fig. 64. Aedeagus of *Galeatus scrophicus.* 65. Aedeagus of *Paracopium cingalensis.*

Paracopium cingalensis (Fig. 65).

Basal plates U-shaped; phallotheca slightly sclerotized; a pair of endosomal processes like those of *Galeatus* present; vesica cannot be made out, parameres as in *Galeatus*.

CIMICOIDEA

Miridae.

Polymerus spec. probably *consanguiensis* (Fig. 66).

Basal plates U-shaped; phallotheca oval; vesica in the form of two diverticula, one longer than the other, the longer one lies beneath a pair of sclerites which are strongly chitinised pieces, the longer diverticulum has two more sub-lobes while the short one is fringed with numerous curved hairs at its top; left paramere almost twice the size of the right.

Lygus decoloratus Dist. (Fig. 67).

In the dorsal position the vesica forms a pair of diverticula which become spine-like in the distal region; a single diverticulum lying in the ventral region elongate and uniformly broad; right and left parameres inequal (Fig. 67).

Helopeltis theivora (Fig. 68).

Basal plates U-shaped; ejaculatory duct coiled and continued within the phallus for some distance; phallotheca long, flat, curved and pointed in the distal region; vesical diverticula absent, a giant sclerite present at about the middle of the endosoma (perhaps corresponding with the endosomal sclerites of Reduviidae), endosoma stiff and marked with numerous tubercles and minute spines; left paramere greatly reduced, as if being in the course of disappearence.

Nabidae.

Nabis tibialis (Fig. 69).

Basal plates U-shaped; phallotheca wide, oval and slightly sclerotized; ductus seminis has a spiral lining and forms a coil in the middle; a pair of strongly sclerotised processes present, the one in the dorsomedian portion over the ejaculatory duct being longer; parameres slender in the proximal and flattened in the distal region and originating near the basal plates, as pointed out by PRUTHI (1925).

REMARKS ON CIMICOMORPHA

An exhaustive account pertaining to the relationship of the families of Cimicomorpha has been given by DRAKE & DAVIS (1960). Here only some additional facts shall be added. Considering the ovipositor, the above authors remarked that fusion of first valvifer and eighth paratergite and the accompanying loss of the outer ramus from the first gonapophysis was a condition "unique" to Miridae and Tingidae. But it may be noted that eighth paratergite and first valvifers are fused in Reduviidae and many aquatic Heteroptera and that outer ramus may

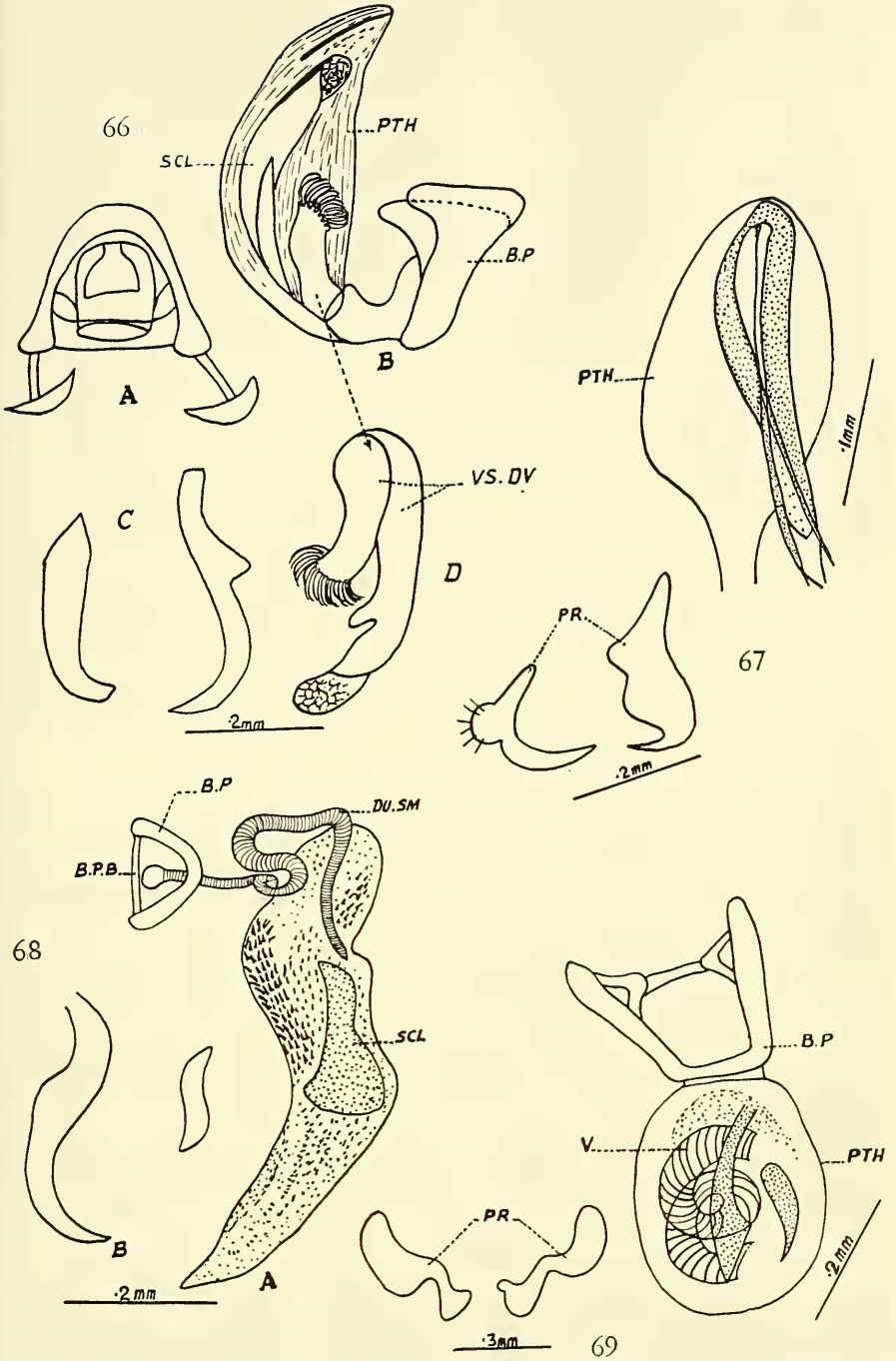


Fig. 66. Aedeagus of *Polymerus* sp. probably *cingalensis* A. Basal plates, B. Aedeagus. C. Vesical diverticulae, D. Parameres. Fig. 67. *Lygus decoloratus* Dist. A. Aedeagus, B. Parameres. Fig. 68. *Helopeltis theivora*. A. Aedeagus, B. Parameres. Fig. 69. Aedeagus and pararameres of *Nabis tibialis*.

KEY TO THE LETTERING OF FIGURES

External female genitalia

INT.ST.MN	=	Inter styloidal membrane.
INT.ST.S.	=	Inter styloidal sclerite.
PR_2	=	Prolongation of the inner ramus of first valvula.
R_1	=	Outer ramus of first valvula.
R_2	=	Inner ramus of first valvula.
R_3	=	Ramus of second valvula.
ST	=	Styloids.
SST_1, SST_2	=	Styloidal sclerites.
TG.AP	=	Tergal apodeme.
VIII	=	Eighth paratergite.
IX	=	Ninth paratergite.
1st. VAL	=	First valvula.
1st. VF	=	First valvifer.
2nd. VAL	=	Second valvula.
2nd. VF	=	Second valvifer.

External male genitalia

B.P.	=	Basal plate.
B.P.B.	=	Basal plate bridge.
B.P.SC	=	Basal plate sac.
CP.PR	=	Capitate process.
D.C.	=	Dorsal connective.
DU.SM	=	Ductus seminis.
END	=	Endosoma.
END.PR	=	Endosomal processes.
F	=	Foramen.
GC	=	Wall of genital chamber.
PR	=	Paramere.
PTH	=	Wall of phallotheca.
S_1 & S_2	=	Portions of struts.
SCL	=	Sclerite.
SK	=	Stalk of basal plate sac.
ST	=	Struts.
V	=	Vesica.
a, b, c		Endosomal sclerites.

Internal male reproductive organs

BL.EJ	=	Bulbus ejaculatorius.
CD	=	Deferent canal.
CE	=	Efferent canal.
CEN.EP	=	Lining epithelium.
D.EJ	=	Ductus ejaculatorius.
INN.EP	=	Investing epithelium.
MD.EP	=	Middle layer of epithelium.
SV	=	Seminal vesicle.
T	=	Testes.
1, 2, 3, 4	=	Mesadene glands.

Entomologische Berichten

De *Entomologische Berichten* worden eveneens door de Nederlandsche Entomologische Vereeniging uitgegeven en zijn bestemd voor de publicatie van kortere artikelen, van faunistische notities etc., alsmede van de Verslagen der Vergaderingen en van mededelingen van het Bestuur. Zij verschijnen twaalf maal per jaar in een aflevering van 16 of meer bladzijden. Deze 12 afleveringen vormen samen een deel.

Alle zakelijke correspondentie betreffende de Vereniging te richten aan de Secretaris, G. L. van Eyndhoven, Zeeburgerdijk 21, Amsterdam-O.

Alle correspondentie over de redactie van het Tijdschrift voor Entomologie te richten aan de Redacteur, Dr. A. Diakonoff, Rijksmuseum van Natuurlijke Historie, Leiden.

Alle correspondentie over de redactie van de Entomologische Berichten te richten aan de Redacteur, B. J. Lempke, Oude IJselstraat 12III, Amsterdam-Z. 2.

Alle betalingen te richten aan de Penningmeester, Drs. H. Wiering, Lorentzweg 183, Hilversum, postgiro 188130, ten name van de Nederlandsche Entomolosche Vereeniging te Hilversum.

Alle correspondentie betreffende de Bibliotheek der Vereniging te richten aan de Bibliotheek, Zeeburgerdijk 21, Amsterdam-O.

Notice to Subscribers

All correspondence referring to subscriptions and exchange subscriptions of the periodicals of the Netherlands Entomological Society should be addressed to the Librarian, Zeeburgerdijk 21, Amsterdam-Oost.

NOTICE TO CONTRIBUTORS

Contributors will receive free of charge fifty reprints of their papers, joint authors have to divide this number between them at their discretion. Additional reprints may be ordered when returning proofs ; they will be charged at about two Dutch cents per page.

Manuscripts should be written in Dutch, English, French, German or Italian. If they contain descriptions of new genera, species, etc., they should be in one of the four last mentioned languages : only when the descriptions form a minor part of the paper, the manuscript may be written in Dutch, with the descriptions in one of these languages. Papers in Dutch should contain a short summary in one of these four languages.

Manuscripts should be typewritten in double spacing on only one side of the paper, with a margin of at least three cm at the left side of each sheet. Paragraphs should be indented. Carbon copies cannot be accepted, as handling makes them illegible.

Captions for text figures and plates should be written on a separate sheet in double spacing, numbered consecutively in arabic numerals ; the use of a, b, c, or any other subdivision of the figure numbering should be avoided.

Drawings for reproduction should be on good paper in Indian ink, preferably at least one and a half times as large as the ultimate size desired. Lettering should be uniform, and, after reduction, of the same size. Photographs should be furnished as glossy positive prints, unmounted. Plates should be arranged so as to fill a whole page (11.5 x 19 cm) of the *Tijdschrift*, or a portion thereof. Combinations of illustrations into groups are preferable to separate illustrations since there is a minimum charge per block.

Names of genera and lower systematic categories, new terms and the like are to be underlined by the author in the manuscript by a single straight line. Any other directions as to size or style of the type are given by the editors, not by the author. Italic type or spacing to stress ordinary words or sentences is to be avoided. Dates should be spelled as follows : either "10.V.1948" or "10 May, 1948". Other use of latin numerals should be avoided, as well as abbreviations in the text, save those generally accepted. Numbers from one to ten occurring in the text should be written in full, one, two, three, etc. Titles must be kept short. Footnotes should be kept at a minimum.

Authors will be charged with costs of extra corrections caused by their changing of the text in the proofs.

Bibliography should not be given in footnotes but compiled in a list at the end of the paper, styled as follows :

Mosely, M. E., 1932. "A revision of the European species of the genus *Leuctra* (Plecoptera)". Ann. Mag. Nat. Hist., ser. 10, vol. 10, p. 1—41, pl. 1—5, figs. 1—57.

Text references to this list might be made thus :

"Mosely (1932) says...." or "(Mosely, 1932)".

The editors reserve the right to adjust style to certain standards of uniformity.

Manuscripts and all communications concerning editorial matters should be sent to Dr. A. DIAKONOFF, Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands.